[DOCUMENT NAME] CLAIMS

[CLAIM 1]

An apparatus for processing the surface of an object to be processed by spraying a processing gas onto said object, said apparatus comprising:

a processor having a group of hole-rows composed of hole-rows each extending in one direction and arranged each other in a side-by-side relation at equal pitches in a direction intersecting with the extending direction of each of said hole-rows, the processing gas being blown through each of said hole-rows; and

a moving mechanism for relatively moving said processor in a direction intersecting with the side-by-side arranging direction with respect to said object.

[CLAIM 2]

A surface processing apparatus according to claim 1, wherein the relatively moving direction is along the extending direction of each of said hole-rows.

[CLAIM 3]

A surface processing apparatus according to claim 1, wherein the extending direction of each of said hole-rows and the side-by-side arranging direction of said hole-rows are orthogonal to each other and the relatively moving direction is along the extending direction.

[CLAIM 4]

A surface processing apparatus according to claim 1, wherein the extending direction of each of said hole-rows is slanted with respect to the relatively moving direction.

[CLAIM 5]

A surface processing apparatus according to claim 1, wherein the extending direction of each of said hole-rows is slanted with respect to the

relatively moving direction and the side-by-side arranging direction of said hole-rows is orthogonal to the relatively moving direction.

[CLAIM 6]

A surface processing apparatus according to claim 1, wherein the extending direction of each of said hole-rows is slanted with respect to the relatively moving direction and the side-by-side arranging direction of said hole-rows is orthogonal to the extending direction.

[CLAIM 7]

A surface processing apparatus according to claim 4, wherein one end part in the extending direction of one of two hole-rows disposed adjacent or every predetermined hole-row(s) of all said hole-rows is located on a same linear line along the relatively moving direction as the other end part in the extending direction of the other of said two hole-rows.

[CLAIM 8]

A surface processing apparatus according to claim 1, wherein said pitches each are set to be generally equal to an effective processing width when a distance between said hole-rows and said object is set to a neighborhood of the upper limit of an effective range.

[CLAIM 9]

A surface processing apparatus according to claim 1, further comprising a swing mechanism for relatively swinging said processor in a direction intersecting with the relatively moving direction with respect to said object.

[CLAIM 10]

A surface processing apparatus according to claim 1, wherein said processor includes a plurality of stages of said group of hole-rows in the extending direction, and hole-rows of one of two adjacent stages of said plurality of stages are deviated from hole-rows of the other of said two stages in the side-by-side arranging direction.

[CLAIM 11]

A surface processing apparatus according to claim 10, wherein an amount of said deviation is 1/n (n is the number of stages of the hole-row groups) of said pitch.

[CLAIM 12]

A surface processing apparatus according to claim 1, wherein said processor includes a plurality of stages of said hole-row groups in the extending direction, and

said apparatus further comprises:

a first swing mechanism which relatively swings a hole-row group of one of two adjacent stages of said plurality stages in a direction intersecting with the relatively moving direction with respect to said object; and

a second swing mechanism which relatively swings a hole-row group of the other of said two stages in the same direction as the relatively swinging direction of said first swing mechanism with the phase shifted from that of said first swing mechanism.

[CLAIM 13]

A surface processing apparatus according to claim 1, wherein said processor includes a plurality of electrode members arranged in a side-by-side relation at equal pitches, a slit-like gap as one of said hole-rows is formed between two adjacent electrode members of said plurality of electrode members,

a processing gas for plasma processing said object being passed through said gap.

[CLAIM 14]

A surface processing apparatus according to claim 13, wherein said processor includes a plurality of electrode modules separatably connected in the side-by-side arranging direction of said hole-rows,

each of said electrode modules includes a plurality of electrode members arranged in a side-by-side relation at equal pitches and constitutes a part of said hole-row group.

[CLAIM 15]

A surface processing apparatus according to claim 14, wherein said adjacent two electrode modules each have an end electrode member arranged at mutually opposing ends, said end electrode member of one of said two electrode modules is put together with said end electrode member of the other of said two electrode modules so that these end electrode members constitute a single combined electrode member,

said combined electrode member being equal in thickness to the other respective electrode members of said adjacent two electrode modules.

[CLAIM 16]

A surface processing apparatus according to claim 1, wherein said processor includes a flow rectification path for uniformizing processing gas, and said hole-rows are continuous with said flow rectification path such that said hole-rows are branched.

[CLAIM 17]

A surface processing apparatus according to claim 14, wherein said processor includes a plurality of module units separatably connected in the side-by-side arranging direction, each of said module units comprises said electrode module and a flow rectification module connected to said electrode module, said flow rectification module includes a flow rectification path for uniformizing processing gas, and hole-rows of said electrode module are connected to said flow rectification path such that said hole-rows are blanched in each of said module unit.

[CLAIM 18]

A surface processing method comprising the step of:

blowing a processing gas through each of a plurality of hole-rows arranged in a side-by-side relation in a direction at equal pitches on a processor so as to be sprayed onto an object to be processed while relatively moving said processor in a direction intersecting with the side-by-side arranging direction with respect to said object.

[CLAIM 19]

A surface processing method according to claim 18, wherein the step includes blowing said processing gas while relatively moving said object along the extending direction of each of said hole rows.

[CLAIM 20]

A surface processing method according to claim 18, wherein the step includes blowing said processing gas while relatively slantwise moving said object with respect to the extending direction of each of said hole-rows.

[CLAIM 21]

A surface processing method according to claim 18, wherein said pitch is set to be approximately equal to an effective processing width when a distance between said hole-rows and said object is in a neighborhood of the upper limit of an effective range and the step includes processing under such a condition that said distance is in a neighborhood of the upper limit of said effective range.

[CLAIM 22]

A surface processing method according to claim 18, wherein said processor is constituted by arranging a plurality of stages of hole-row groups composed of hole-rows having said equal pitches in the extending direction of each of said hole-rows and the adjacent two stages of said hole-row groups are deviated in the side-by-side arranging direction,

said relative movement being conducted with respect to said plurality of stages of said hole-row groups altogether.

[CLAIM 23]

A surface processing method according to claim 18, wherein the step includes blowing said processing gas while further relatively swinging said processor in a direction intersecting with said relatively moving direction with respect to said object.

[CLAIM 24]

A surface processing method according to claim 23, wherein a swinging width of said swinging motion is set to be 1/2 or slightly larger than 1/2 of said pitch.

[CLAIM 25]

A surface processing method according to claim 23, wherein the cycle of said swinging motion is set to be 1/m times (m: integer) of a required time for said object to relatively move by a distance corresponding to the length of said hole-row.

[CLAIM 26]

A surface processing method according to claim 18, wherein said processor is constituted by arranging a plurality of stages of hole-row groups composed of hole-rows having said equal pitches in the extending direction of each of said hole-rows,

in parallel with said relative movement, said hole-rows of the adjacent stages being relatively swung in a way as to be deviated in phase in a direction intersecting with said relatively moving direction with respect to said object.

[CLAIM 27]

An apparatus for plasma processing an object to be processed by jetting a processing gas through a plasmatizing space and applying the processing gas onto an object arranged outside said plasmatizing space, said apparatus comprising:

a first electrode module and a second electrode module arranged each other in side-by-side relation in one direction,

said first and second electrode modules each include a plurality of electrode members arranged in side-by-side relation in the same direction as the side-by-side arranging direction of said first and second electrode modules, and a support part for connecting and supporting said electrode members,

a gap serving as said plasmatizing space is formed between every adjacent electrode members,

a first end electrode member of all said electrode members of said first electrode module located at an end on said second electrode module side and a second end electrode member of all said electrode members of said second electrode module located at an end on said first electrode module side are combined to form a single combined electrode member, and

electrode members other than said first end electrode member of said first electrode module, said combined electrode member and electrode members other than said second end electrode member of said second electrode module are arranged at equal pitches with respect to one another.

[CLAIM 28]

A plasma processing apparatus according to claim 27, wherein said first end electrode member and said second end electrode member, i.e. said combined electrode member, are electrically grounded.

[CLAIM 29]

A plasma processing apparatus according to claim 27, wherein in said first electrode module, said first end electrode member integrally includes a first enlarged-thickness part protruding toward said second electrode module, and a first reduced-thickness part which is smaller in

thickness than said first enlarged-thickness part and withdrawn to the opposite side of said second electrode module side,

in said second electrode module, said second end electrode member integrally includes a second reduced-thickness part which is withdrawn to the opposite side of said first electrode module side and a second enlarged-thickness part which is bigger in thickness than said second enlarged-thickness part and protruding toward said first electrode module, and

in said combined electrode member, said first enlarged-thickness part and said second reduced-thickness part are put together with each other and said first reduced-thickness part and said second enlarged-thickness part are put together with each other.

[CLAIM 30]

A plasma processing apparatus according to claim 29, wherein a temperature adjusting path is formed within said first enlarged-thickness part and said path allows a fluid for adjusting the temperature of said first end electrode member to pass therethrough.

[CLAIM 31]

A plasma processing apparatus according to claim 27, wherein said combined electrode member is divided into a plurality of partial electrode members along a width direction intersecting with the side-by-side arranging direction of said first and second electrode modules, one of the adjacent partial electrode members is supported by said support part of said first electrode module thereby constituting said first end electrode member, and the other of the adjacent partial electrode members is supported by said support part of said second electrode module thereby constituting said second end electrode member.

[CLAIM 32]

A plasma processing apparatus according to claim 31, wherein a temperature adjusting path is formed within said partial electrode member and said path is allowed a fluid for adjusting the temperature to pass therethrough.

[CLAIM 33]

A plasma processing apparatus according to claim 27, wherein the respective electrode members of said first and second electrode modules each have a plate-like configuration intersecting with the side-by-side arranging direction of said first and second electrode modules, the plate-like respective electrode members other than said first end electrode member of said first electrode module, said plate-like combined electrode member and said plate-like respective electrode members other than said second end electrode member of said second electrode module are equal in thickness.